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## EXECUTIVE SUMMARY

This Final Report details Energy Conservation Opportunities (ECOs) for the Laundry and Boiler Plant at Fort Bragg, North Carolina. The ECOs noted in the table on the next page were evaluated for individual energy savings and are recommended for implementation.

The energy savings and implementation costs for each measure are summarized on the following page in order of decreasing savings-to-investment (SIR) ratio. ECIP life cycle cost analyses were performed on all ECOs as a preliminary step, though all of the measures will fall into other funding categories.

Because of the high internal heat gain produced in the Laundry, coupled with the fact that the laundry is not air conditioned, building envelope measures do not produce any energy savings. The most viable ECOs are related to the Boiler Plant (Boiler Replacement), recovering energy wasted in the wash water (Rinse Water Reuse) or utilizing Low Temperature Wash Water, and Changing the Hours of Laundry Operation. Additional operation and maintenance items are listed that can be addressed by the Directorate of Engineering and Housing (DEH) or the Laundry contractor, Integrity Management International, Inc., to generate quick energy savings. There are also several items included that will not produce energy savings but will improve the comfort level of the Laundry. These items should be given consideration as a method of improving productivity and/or employee morale. All ECOs evaluated by the project team are described in detail with engineering calculations for each following in Appendix 2.

The Laundry services at Fort Bragg are under contract to Integrity Management International, Inc. The contractor provides personnel to operate and manage the Laundry and Boiler Plant. The contract between Integrity Management International and the Government stipulates that the Government shall furnish all utility fuels for the Boiler Plant at no cost to the Contractor up to a maximum combined utility fuel heat content of 57,088 mega BTU/annum. When this figure is exceeded the Contractor shall be required to reimburse the Government for any excesses at the current utility fuel unit cost. Utilizing the conversion factors specified in the Contract's Statement of Work, the Laundry uses 46,235 MBTUs of fuel in the Boiler Plant. The current maximum level is such that it does not give the Contractor an incentive to conserve energy. However, the maximum level could be exceeded if there were a significant increase in production level.

There are seven operational and maintenance measures that are recommended for implementation. Some of these could be implemented by an outside contractor, or all of these could be implemented by in-house personnel. If they are all implemented utilizing in-house personnel, they are estimated to save 524.2 MBTUs (4,825 therms and 12,192 KWH) annually at a cost of \$3,529. There are five ECOs that are considered for implementation: Rinse Water Reuse, Boiler Replacement, Energy-Efficient Fluorescent Lamps, Low Temperature Washing, and Change Laundry Operating Hours. Since Energy-Efficient Fluorescents has a higher SIR by replacing them at burnout as a Low Cost/No Cost measure, the savings will not be included as an ECM. Recommended for implementation are Low Temperature Washing, Change Laundry Operating Hours, and Boiler Replacement. The estimated annual savings from these three ECOs

is 8,256 MBTU (82,560 therms) and \$64,954 at a total cost of \$112,439. The Rinse Water Reuse ECO would not be implemented if the Low Temperature Washing ECO is implemented. The total annual savings from the recommended ECOs and Low Cost/No Cost measures is 8,780 MBTU (87,385 therms and 12,192 KWH) and \$69,003 at a cost of \$115,968. Total energy usage at the Laundry would be decreased by 16.7%. Funding documentation for the Rinse Water Reuse, Boiler Replacement, and Energy-Efficient Fluorescents ECO is included in Appendix 3. Documentation was not completed for the other two ECOs since they do not have an implementation cost. Table 1 on the following page lists all recommended ECOs and Low Cost/No Cost measures.

On the pages following Table 1 are brief descriptions of each of the recommended ECOs and Low Cost/No Cost measures. Following these descriptions are five figures. Figure 1 is a pie chart showing the sources of energy consumed in the Laundry in MBTU. Figures 2, 3 and 4 indicate where each of these energy sources are consumed in the Laundry. Figure 5 indicates the amount of energy that will be saved if all the recommended ECOs and Low Cost/No Cost measures are implemented.

TABLE 1

## RECOMMENDED ENERGY CONSERVATION OPPORTUNITIES

ECO	Funding Category	Project Cost (\$)	(MBTU)	Annual Savings (Therms)	(KWH)	(\$)	Simple Payback (yrs)	SIR
1. Boiler Replacement	PECIP	112,439	5,557	55,570	-	29,230	3.8	6.1
2. Low Temperature Wash	-	0	2,699	26,990	-	14,197	0	
3. Change Laundry Operating Hours	-	0	0	-	-	21,527	0	
4. Rinse Water Reuse*	QRIP	12,129	2,469	24,693	-	12,987	0.9	25.3
Totals *		112,439	8,256	82,560	-	64,954	1.7	

\*ECO #4 (Rinse Water Reuse) is not included in the totals since it is not recommended for implementation if the Low Temperature ECO is implemented.

LOW COST/NO COST MEASURES	Project Cost (\$)	(MBTU)	Annual Savings (Therms)	(KWH)	(\$)	Simple Payback (yrs)	SIR
1. Window A/C Covers	48	3.6	36.3	-	19	2.5	9.5
2. Pipe Insulation	7	4.2	42.1	-	22	0.3	78.4
3. Replace Fluorescents with Energy Efficient at Burnout	27	3.3	-	957	61	0.4	29.1
4. Repair Leak on Boiler #1							
In-house Personnel	89	165	1,650	-	868	0.1	231.1
Outside Contractor	129	165	1,650	-	868	0.2	151.5
5. Repair Various Steam Leaks							
In-house Personnel	589	129	1,290	-	679	0.9	27.3
Outside Contractor	629	129	1,290	-	679	0.9	24.2
6. Disconnect Boiler #3 Piping							
In-house Personnel	339	181	1,807	-	950	0.4	66.3
Outside Contractor	379	181	1,807	-	950	0.4	56.2
7. Replace Motors with Energy-Efficient Models	2,430	38.3	-	11,235	1,450	1.7	7.7
Totals**	3,529	524.4	4,825	12,192	4,030	0.9	

\*\*These totals are basis using in-house personnel.

## RECOMMENDED ENERGY CONSERVATION OPPORTUNITIES

The recommended energy conservation opportunities (ECOs) evaluated for the Fort Bragg Laundry and Boiler Plant are described below.

### Rinse Water Reuse

Estimates of the amount of water utilized in all of the washers were made based on the flow of water leaving the hot water converter in the Boiler Plant. The percentage of water used for wash water versus rinse water was made based on the observation of several wash cycles, fill time required for each cycle, and manufacturer's literature for fill capacity. Several readings were taken of drain water temperatures. Presently, the Laundry is discharging all wash and rinse water to drain. It is recommended that a separate drain be constructed for the rinse water. A diverting valve would be required to direct the water to the correct drain. A sump pump would be required to pump the rinse water back to the washers to be used as wash water. This would supply 20 percent of the wash water requirements. This ECO would not be recommended for implementation if the low temperature washing ECO is implemented.

### Boiler Replacement

The Laundry Boiler Plant presently has three boilers: one 800 hp and one 900 hp oil/gas-fired boilers and one coal-fired boiler. The coal-fired boiler is not used. Both gas/oil -fired boilers are utilized, though not at the same time. The average output of the boiler is 12,998 lbs/hr which remains approximately constant throughout the day and year-round. This corresponds to 390 hp. However, the boiler should be sized for the largest load for any month, or 16,167 lbs/hr. This corresponds to a 484 hp boiler. A 500 hp boiler is recommended for replacement. The existing boilers are operating at approximately 72 percent combustion efficiency. It is recommended that the existing coal-fired boiler be removed and replaced with a new, dual-fired boiler to match the plant requirements more closely. The new boiler would operate at approximately 80 percent combustion efficiency since it would be at full-load. The boiler would be a packaged, fire-tube boiler with firing capabilities for both natural gas and #2 fuel oil. The electric costs for operating the new boiler are estimated to be approximately the same as either of the existing boilers.

### Energy-Efficient Fluorescent Lamps

The Laundry presently has 121 fluorescent fixtures with two four-foot lamps each and 30 fluorescent fixtures with four four-foot lamps each. These four-foot lamps are a combination of both 34 watt energy-efficient lamps and 40 watt standard lamps. It is estimated that approximately 75 percent of the existing lamps are the standard 40 watt lamps. It is recommended that all lamps be checked and all 40 watt lamps be replaced with energy-efficient lamps.

### Low Temperature Washing

The Laundry is presently using cold water, hot water, and hot water with steam injection in the washers, depending on the item being washed. Approximately ninety percent of the items washed require some level of hot water. The Veteran's Administration has done extensive research in this area and has found that 110 degrees should be the minimum temperature utilized for most types of clothing. This will insure that the present level of cleanliness and sanitation are maintained.

New punched cards that activate the machines would be required. The chemical manufacturer's representative would do this at no cost. Also, the types of chemicals and detergents used would be changed. These are estimated to cost approximately the same as the present chemicals. The only drawback to implementing this ECO is that productivity would decrease. It is estimated to take 25-75 percent longer to wash with low temperature water versus hot water. Since a contractor operates the laundry, this would have to be a part of future contracts.

### Change Laundry Operating Hours

The Laundry is presently operated from 7:00 a.m. to 3:30 p.m. five days per week. The Laundry receives electricity from the Post main substation. It is not separately metered. The main substation is billed both an on-peak and off-peak demand each month. The time of day this demand occurs is always during the Laundry operating hours. By changing the operating hours to any 8.5 hours period between 4:00 p.m. and 7:00 a.m., the Post substation can save the amount of demand cost that the Laundry contributes. There would be no cost to implement this ECO, but it is estimated that fifty percent of the savings could be given to the contractor as an incentive to change the hours of operation.

## OPERATION AND MAINTENANCE MEASURES

In many instances considerable energy conservation can be achieved through revisions in day-to-day operation and maintenance schedules, using more energy efficient lamp replacements, educating facility users in more efficient energy use, etc. Generally, these measures are not capital intensive and therefore have an investment payback of less than one year or a very small implementation cost. The following are opportunities observed to conserve energy through operation and maintenance measures.

### Heating, Ventilating and Air Conditioning

- a. Window air conditioner covers. There are six window air-conditioners in the office and breakroom areas. During the winter months, these air conditioners are a source of infiltration both around the perimeter and through the unit. It is recommended that an air-conditioner cover be installed over the exterior of the unit during the heating season. This will save on infiltration losses and hence, heating energy. This measure would be done by in-house personnel due to the low cost involved.
- b. Pipe insulation. There are approximately twelve feet of uninsulated domestic hot water pipe in the men's restroom and 145 feet of uninsulated domestic hot water piping between the men's and women's restroom. It is proposed that the twelve feet in the men's restroom be insulated and that the supply line in the women's restroom be valved off. There is never any hot water available in the women's restroom now, so this would not present any inconvenience not presently existing. This measure would be done by in-house personnel due to the low cost involved.
- c. Perform regularly scheduled maintenance as required by equipment manufacturer.

### Lighting

- a. Replace fluorescents with energy-efficient lamps at burnout. The Laundry has 362 four-foot fluorescent lamps throughout the building. It is estimated that 75 percent of these are 40-watt lamps and 25 percent are 34-watt, energy-efficient lamps. It is proposed that the 272 40-watt lamps be replaced with 34-watt, energy-efficient lamps on burn out. The feasibility of replacing all the lamps as a group was evaluated as an ECO. Since this measure is to replace lamps at burnout, it would not be feasible to use a contractor. Only the additional cost of the lamp is utilized since the labor would not be additional cost. The Life Cycle Cost Analysis is basis the lamps that would be replaced during the first year.
- b. Clean reflectors, lamps and replace yellowed diffusers. This will not save energy, but will make better use of the energy being consumed.



### Steam System

- a. Repair leak on Boiler #1. The steam drum for Boiler #1 has a small leak. It is recommended that the gap be welded closed during the boiler shutdown period.
- b. Repair various steam leaks at flanges, valves, and fittings in the Boiler Plant. Approximately five minor steam leaks were observed in the Boiler Plant at various valves, flanges and fittings. It is recommended that the valves and fittings be repaired or replaced, if necessary, to stop the steam leaks.
- c. Disconnect steam piping to Boiler #3. Boiler #3 is an old coal-fired boiler that is no longer utilized. The steam pipe from the boiler to the main steam header is still connected and some steam is allowed to pass through the pipe. It is recommended that this pipe be disconnected and closed off at the main header. This measure could be done by in-house personnel or by an outside contractor.

### Process and Miscellaneous

- a. Replace motors on failure with energy-efficient models. The Laundry utilizes several three-phase AC motors. The ones addressed in this measure drive the air compressors, boiler fans and circulating water pump. It is recommended that each of these motors be replaced with an energy-efficient model as they burnout. The only extra costs incurred would be the difference in cost between the standard efficiency motor and an energy-efficient electric motor. Savings and costs shown below are basis all motors having been replaced. Since these would be replaced at burnout, it would be done by in-house personnel and not by an outside contractor.
- b. Any damaged or missing seals on dryer doors should be repaired and/or replaced and the dryer controls kept free of lint.
- c. Lint should be cleaned from all motors monthly. They were all covered with lint during the field survey, which prevents them from cooling properly. This will not save energy, but will extend the life of the motors due to cooler operating temperatures.

# LAUNDRY ENERGY CONSUMPTION BY SOURCE

( TOTAL CONSUMPTION = 52,595 MBTU )

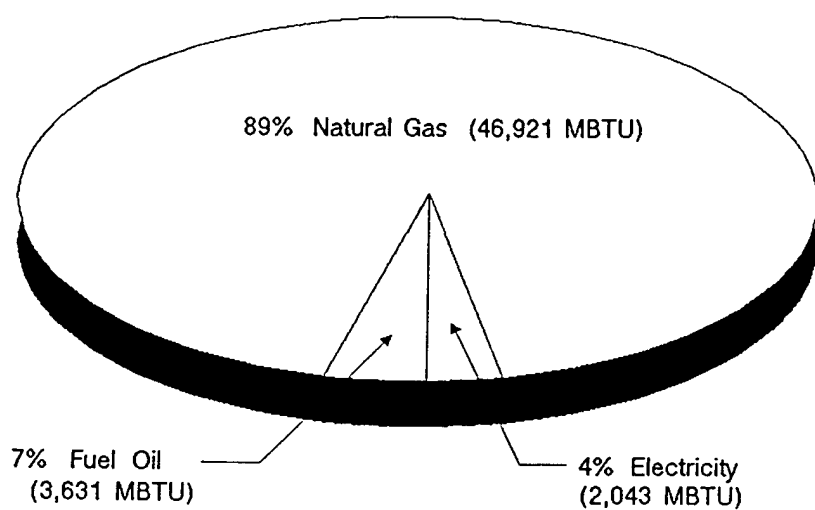


FIGURE 1

# LAUNDRY ELECTRICAL ENERGY BALANCE

( TOTAL CONSUMPTION = 2043 MBTU )

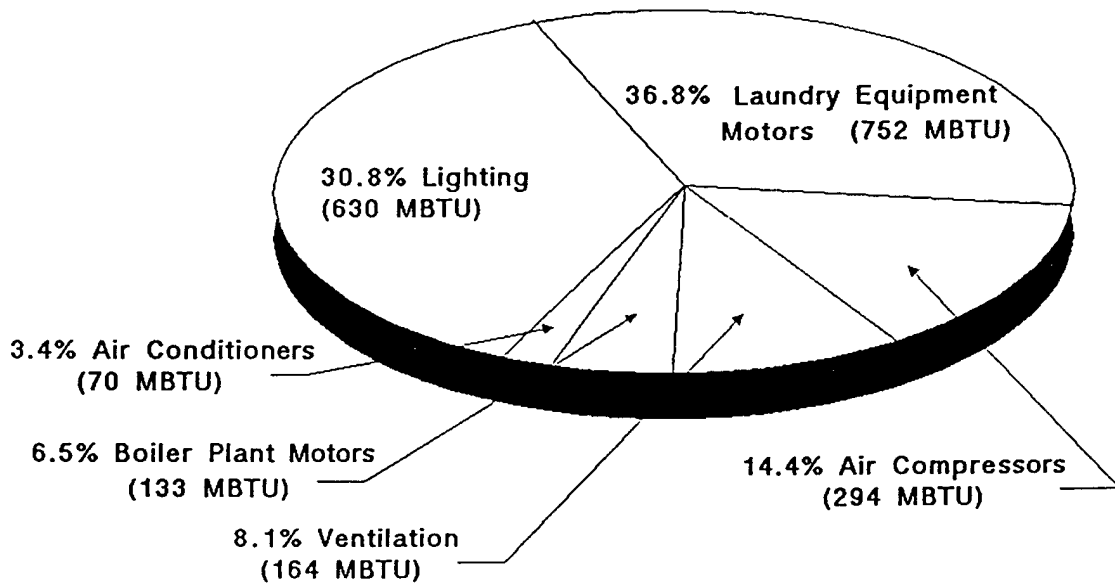


FIGURE 2

# LAUNDRY NATURAL GAS ENERGY BALANCE

( TOTAL CONSUMPTION = 46,921 MBTU )

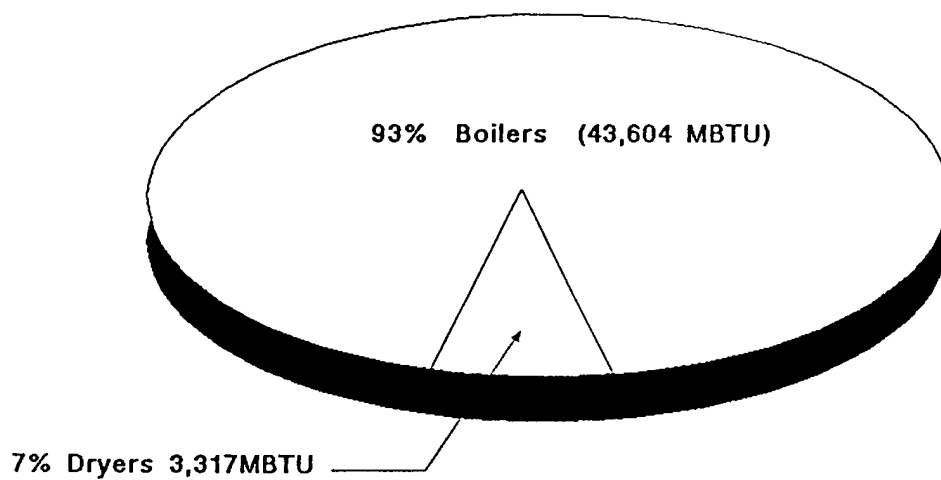


FIGURE 3

# LAUNDRY FUEL OIL ENERGY BALANCE

( TOTAL CONSUMPTION = 3,631 MBTU )

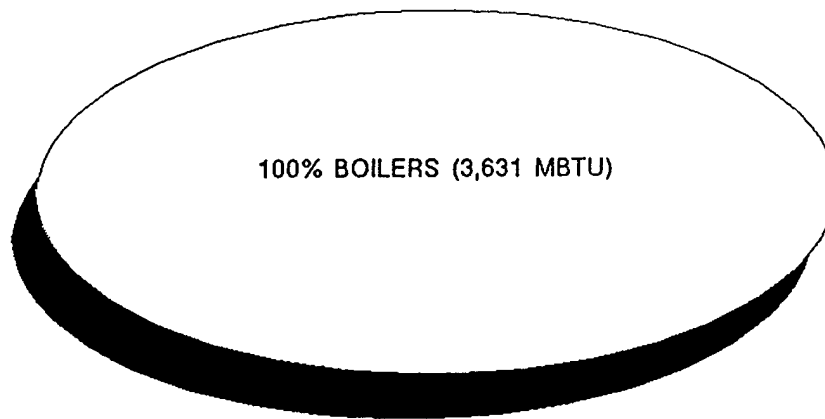


FIGURE 4

# ENERGY SAVINGS FOR LAUNDRY

WITH IMPLEMENTATION OF RECOMMENDED OPERATION  
AND MAINTENANCE ITEMS AND ENERGY CONSERVATION OPPORTUNITIES  
(PRESENT TOTAL CONSUMPTION = 52,595 MBTU)

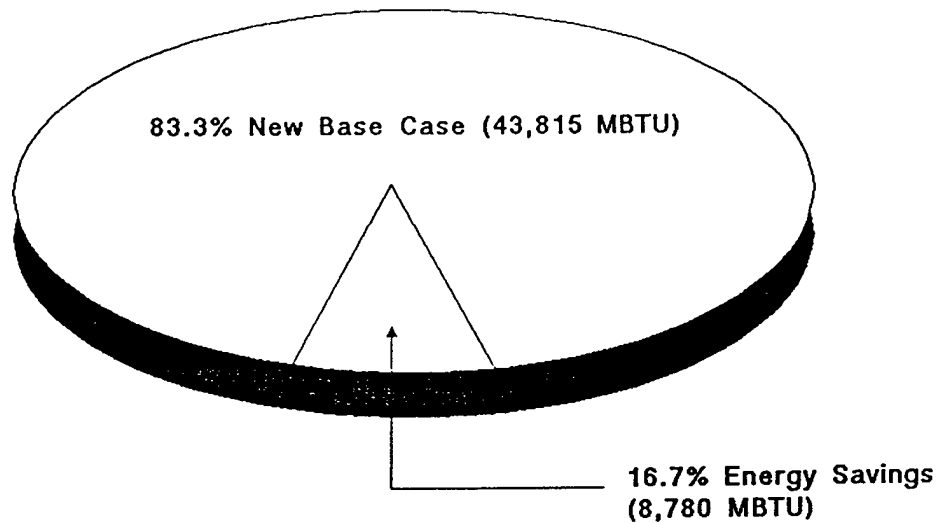


FIGURE 5